Annual Project Summary

Mid-America Integrated Seismic Networks -VPI

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INVESTIGATIONS UNDERTAKEN

The Mid-America Integrated Seismic Network (MAISN), is a cooperative effort between the University of Memphis (CERI), St. Louis University, Virginia Tech, the University of South Carolina, the University of Kentucky, and the U.S. Geological Survey. The purposes of the MAISN are twofold:

1. provide scientists, engineers, public and private entities, emergency responders, and the media with rapid and reliable information about felt and damaging earthquakes within a timeframe that maximizes the utility of the information.

2. provide high quality data on a timely basis to the scientific and engineering communities for the purpose of improving:
   a) seismic hazard estimation for urban population centers and the lifelines and critical facilities upon which they depend
   b) estimation and measurement of strong ground motions
   c) our understanding of the basic earthquake process and seismotectonics of earthquake zones, particularly in intraplate regions.

The Virginia Tech component of MAISN collects high-quality seismic data in Virginia and adjacent parts of the Appalachian region. Research objectives include earthquake monitoring to maintain continuity of earthquake catalogs for seismic hazard assessment, studies of the seismotectonics of the region, earthquake source studies, wave propagation, and the temporal/spatial behavior of seismicity. Outreach objectives include development and maintenance of regional earthquake catalogs; and dissemination of information to federal/state/local governments, the engineering community and the general public.

RESULTS

Stations in operation during the report period October 1, 2003 - September 30, 2004 are shown in Figure 1. The stations are 3 component, short-period with 24-bit digitization. Telemetry to the central recording facility on-campus is by duplex digital VHF radio. Strong motion ANSS station CVVA is operated and maintained by CERI: arrival time data from this

station are routinely combined with data from the Virginia Tech network stations and other regional stations to locate shocks in central Virginia and adjacent areas.

The digital network data are ported to an EARTHWORM system and are being exported to USGS NEIC in Golden, Colorado, and to CERI (University of Memphis, Tennessee). Virginia Tech and other collaborative member institutions of MAISN are committed to efficient data acquisition, analysis and dissemination under the auspices of the mid-America region of the Advanced National Seismic System (see website at **http://www.anss-ma.org**).

In addition to the data disemination via EARTHWORM, Va Tech maintains an anonymous ftp site containing waveform data from selected regional events. This is accessible via web browsers at **ftp://vtso.geol.vt.edu/events**. The worldwide web site **http://www.geol.vt.edu/outreach/vtso/** contains information on how to access the waveform data, as well as the other products of this project, which include a regional seismicity bulletin and historical earthquake catalog for the southeastern U.S. region. In addition, the website includes twenty-four hour digital Helicorder trace data from vertical components of the network.

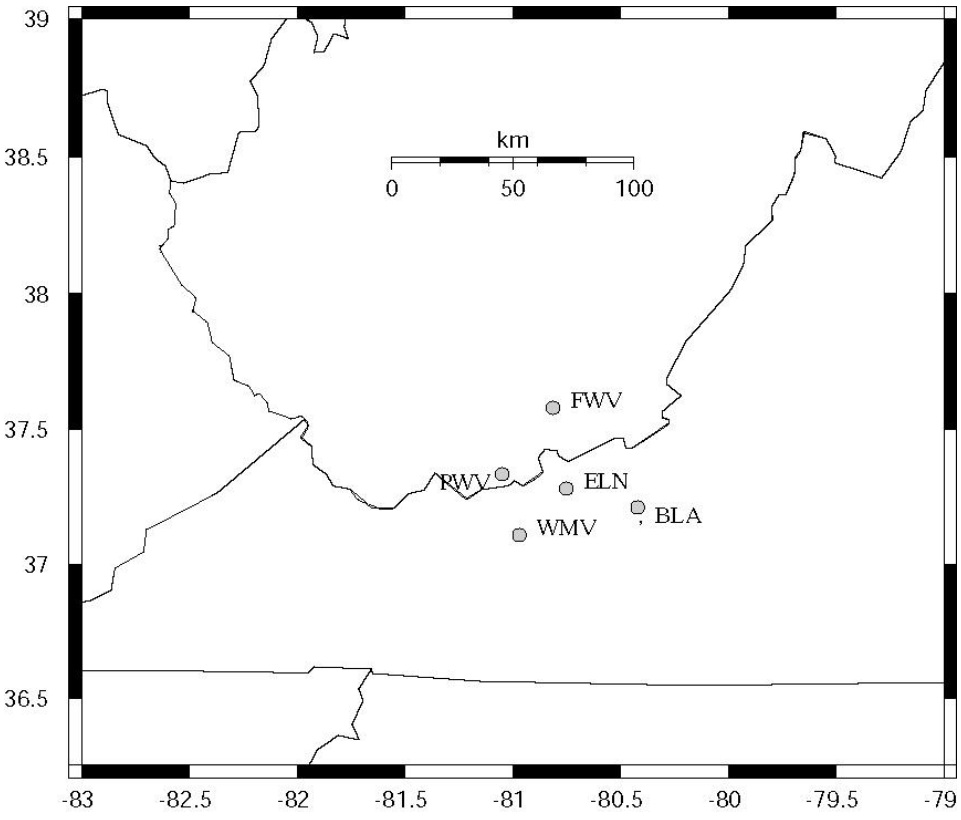


Figure 1. Circles show seismic stations operated by Virginia Tech.

Station WMV was terminated during the report period. The site was located on the crest of Big Walker Mountain in Bland County, Virginia. The only means of access was a

National Forest Service trail right-of-way. The trial is not maintained and only suitable for travel by mule. In addition, frequent episodes of radio interference due to unlicensed operators in the area were a nuisance. The equipment at WMV is being relocated to a site on the campus of Virginia Western Community College in Roanoke, Virginia. Enclosures, radios, computer and power supply equipment for the new site have been secured, and installation should be completed before January 1, 2005. Digital data from the site will be sent by Internet to the Earthworm at Blacksburg, and then exported to NEIC, in Golden and to CERI in Memphis for re-distribution. Plans for the next two years are to relocate two additional stations (FWV and PWV) to sites in Central Virginia were secure locations with Internet access are available. This will provide a means to monitor and better locate shocks in the central Virginia seismic zone, which in recent years has been much more active than the area in western Virginia where the network stations currently reside.

Recent Seismicity in Virginia and the Southeast US

Figure 2 shows the epicenters of earthquakes in the Southeastern U.S. region reported in the 38th volume of the Southeastern United Stated Seismic Network Bulletin, for the year 2003.

2003 was notable for several significant shocks in the southeastern United States. On April 29, 2003, a magnitude mb_{Lg} 4.6 shock occurred at 34.445N 85.620W near Fort Payne, Alabama. Maximum intensity was VI MM. This is the largest instrumentally recorded shock in the eastern Tennessee seismic zone. On May 5, 2003, a magnitude mb_{Lg} 3.9 earthquake occurred in the central Virginia seismic zone at 37.655N, 78.055W, 16hr:32m:33.9sec UT at a depth of 2.8 km, near Cartersville, Virginia. Maximum intensity was V MM. Figure 3 shows the U.S. Geological Survey community internet intensity map for the May 5, 2003 central Virginia shock.

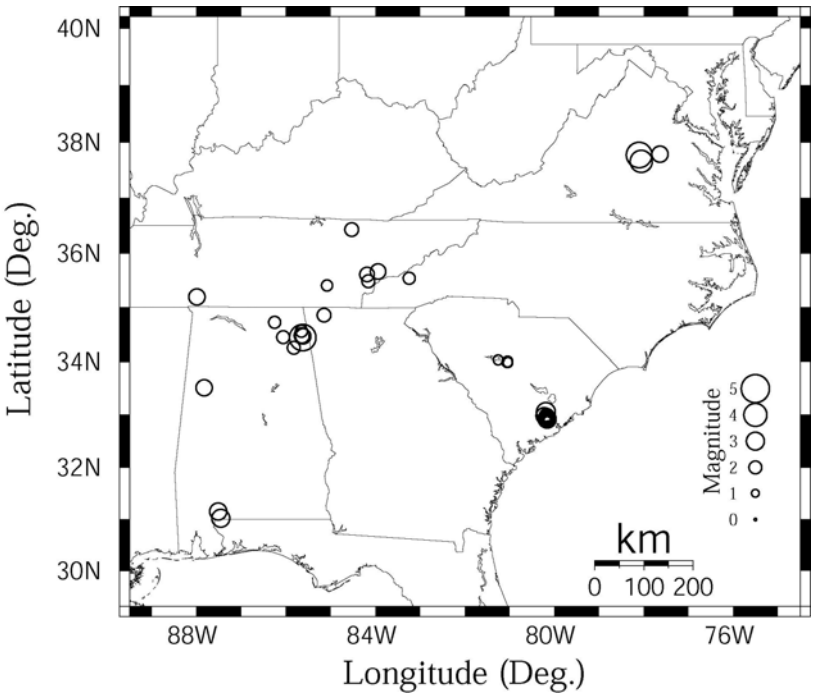


Figure 2. Epicenters of earthquakes occurring during 2003 and contained in the Southeastern U.S. Seismic Network Bulletin No. 38.

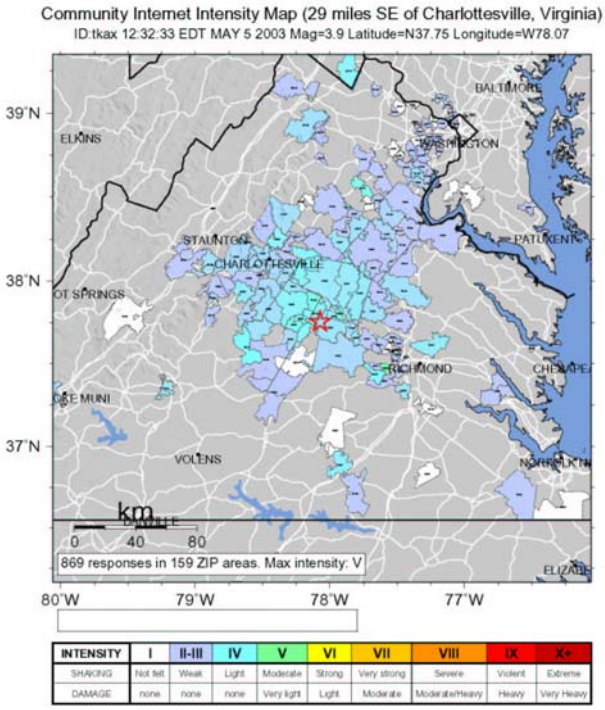


Figure 3: U.S. Geological Survey community internet intensity map of the May 5, 2003 central Virginia earthquake.

On November 6, 2003 a magnitude MD 2.6 (duration equivalent to mb_{Lg}) shock occurred at 37.783 N 77.634W near Rockville, Virginia in the central Virginia seismic zone. It was not reported felt. Figure 4 shows some of the seismograms from this shock recorded in western Virginia by the Virginia Tech network.

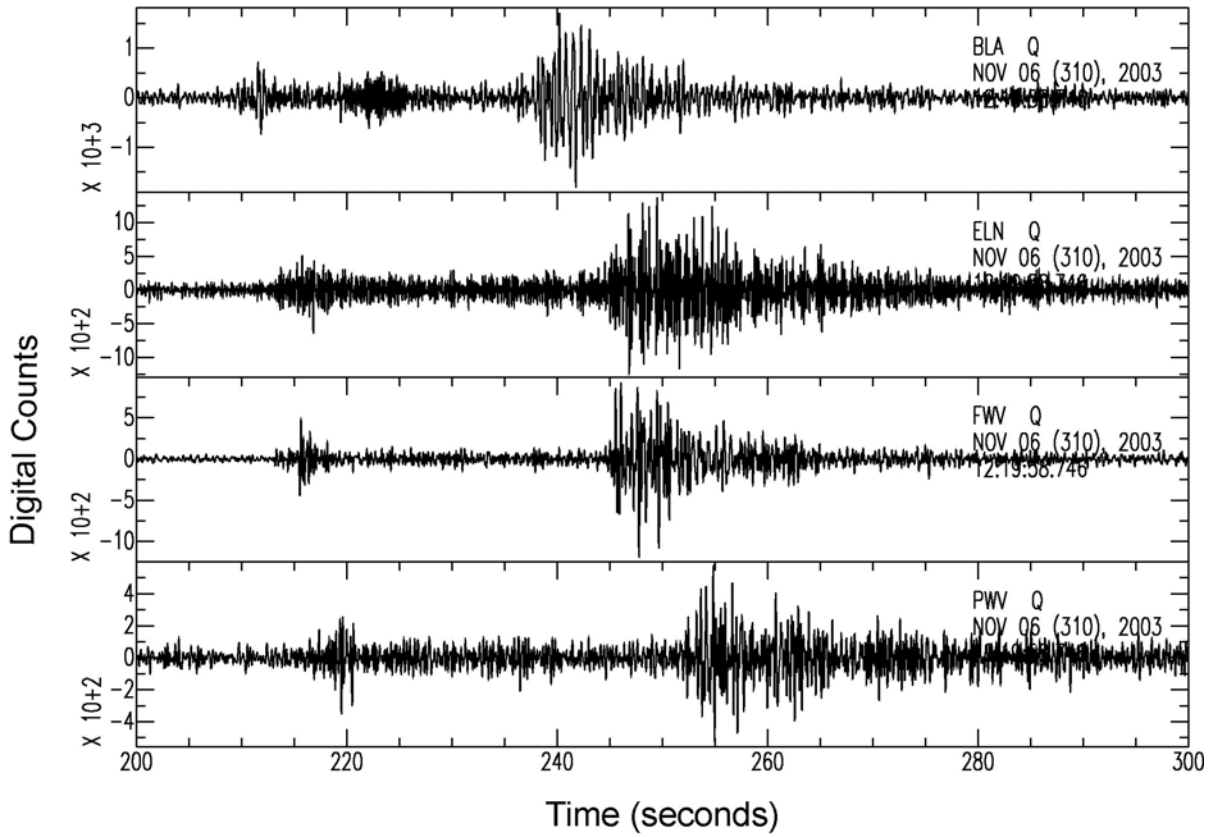
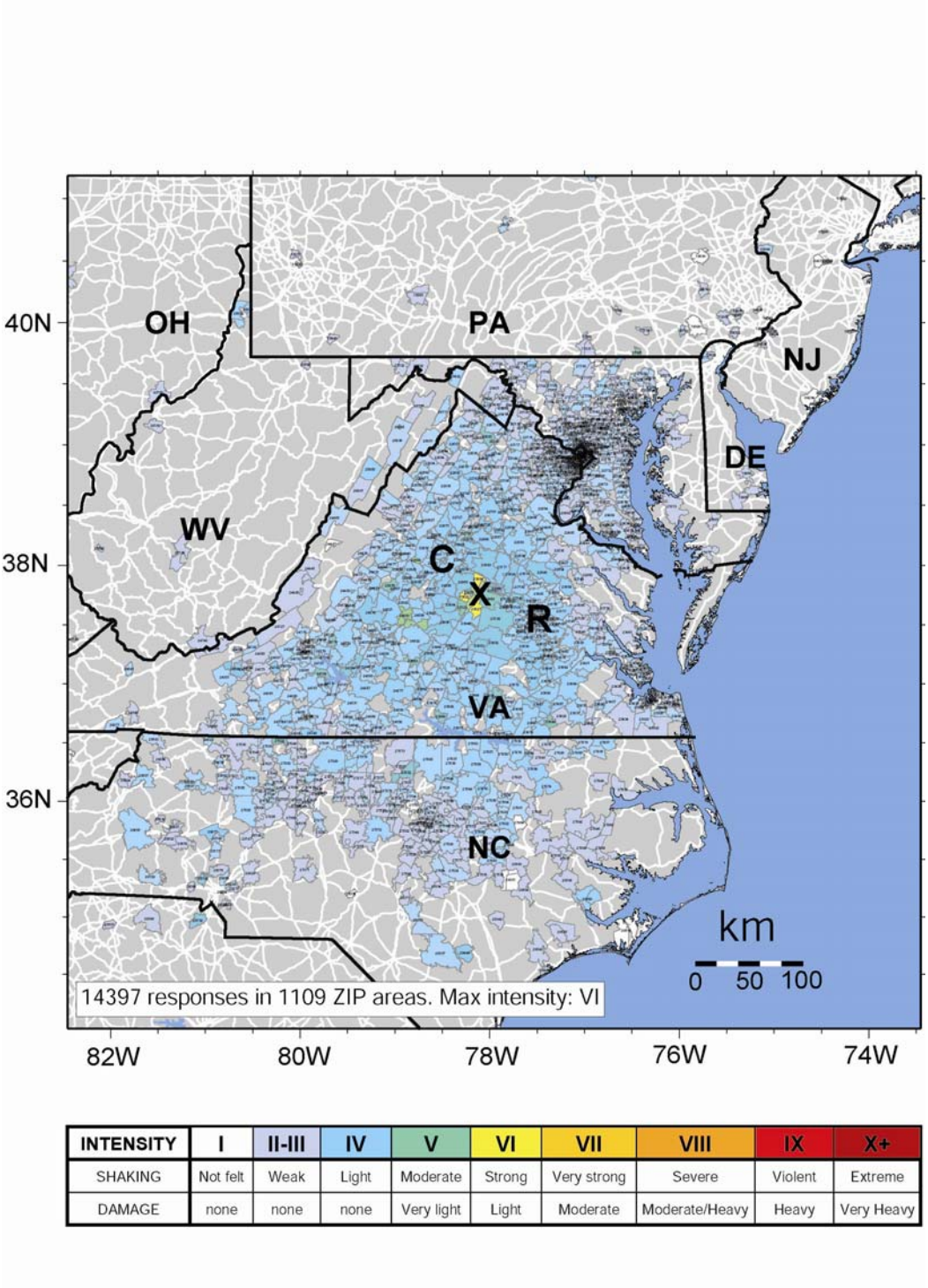


Figure 4: Vertical component recordings of the November 6, 2003 MD 2.6 earthquake near Rockville, Virginia at stations maintained by Virginia Tech.

On December 9, 2003 two magnitude mb_{Lg} 4.5 shocks occurred within 12 seconds in the central Virginia seismic zone, at the same location. The epicenter of this compound event was derived by the author using all available P and S wave arrivals at local and regional stations and a region-specific velocity model, at 37.774N 78.100W. Origin time was 20hr: 59min: 18.7 sec., UT. Depth was fixed at 10 km. The event was reported felt over approximately 200,000 km^2. Maximum intensity reached VI MM, with many instances of the fall of loose objects. Several cases of cracked plaster were reported in newspapers, for localities near the James River. The author is not aware of any reports of damage to chimneys or cracks in masonry walls. On that basis, it would appear that this event was probably somewhat smaller in magnitude than the December 22, 1875 shock that undoubtedly occurred in the same vicinity, and which probably ranks as the largest known shock in the seismic zone. Figure 5 is adapted from the U.S. Geological Survey community internet intensity map of the December 9, 2003 earthquake. The cross shows the instrumental location of the epicenter derived by the author, in good agreement with the area of maximum shaking intensity in western Goochland County, near the small community of Fife.

Seismograms recorded at Virginia Tech regional network stations in western Virginia are shown in Figure 6.



INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy

Figure 5: Modified from the U.S. Geological Survey's community internet isoseismal map for the December 9, 2003 central Virginia earthquake.

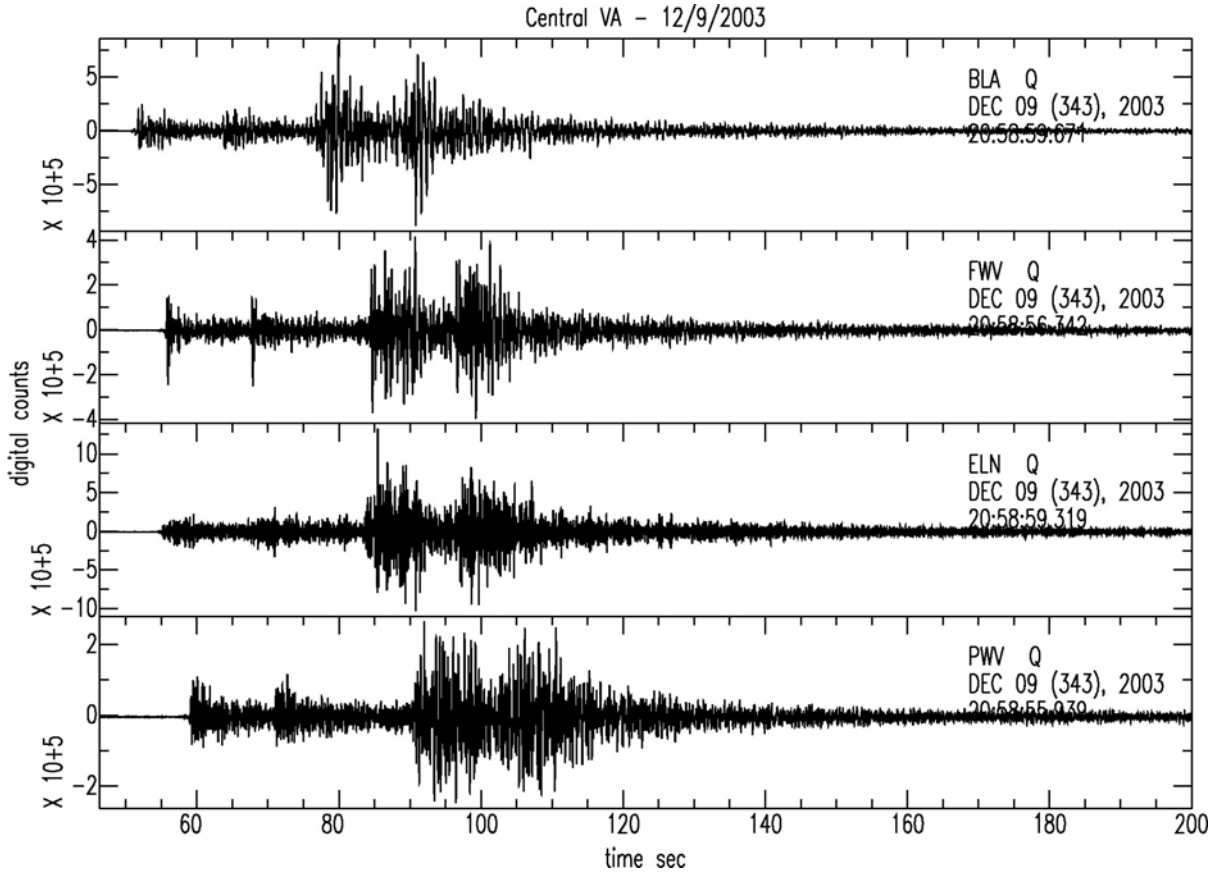


Figure 6: Seismograms recorded by Virginia Tech network stations in western Virginia from the December 9, 2003 central Virginia events. The compound nature of the shock is clearly evident, with a time separation of 12 seconds between virtually identical earthquakes.

NONTECHNICAL SUMMARY

The Virginia Tech seismic network contributes to the earthquake monitoring of the southern Appalachian region of the southeastern United States. Data exchange with collaborating institutions is real-time, continuous. Data products generated by the project during the report period are available on-line, including waveform data for Virginia earthquakes, instrumental earthquake catalogs and a historical catalog of events in the southeastern region. On-line helicorder displays for the vertical component stations are also accessible at web site **www.geol.vt.edu/outreach/vtso**.

REPORTS PUBLISHED

The 37th volume of the Southeastern United States Seismic Network Bulletin for events occurring during the 2002 calendar year was distributed to over 100 institutions and individuals in December, 2003. The bulletin contains complete phase arrival time data from all stations recording each tectonic earthquake, as well as much additional information on southeastern U.S. seismicity and network operation. Text versions of the Southeastern U.S. Seismicity Bulletins can be obtained electronically at the Va Tech website, or by anonymous ftp, at the address/URL cited above.

The 38th volume of the Southeastern United States Seismic Network Bulletin for events in calendar year 2003 is currently be finalized and will be distributed in November, 2004. Hypocenter locations for 2003 events have already been forwarded to the ANSS catalog (see below).

A paper entitled "The 9 December 2003, Mw 4.3 Central Virginia, Earthquake: A Complex Event in the Central Virginia Seismic Zone", by Won-Young Kim and Martin C. Chapman has been submitted for publication in the Bulletin of the Seismological Society of America.

The ANSS Composite Catalog **(http://quake.geo.berkeley.edu/anss/)** currently contains the listing of instrumentally located tectonic earthquake hypocenters and magnitude estimates for the southeastern US region, complete through 2003. Phase arrival time data for events are available on-line in the electronic versions of the SEUSSN bulletins, at the Virginia Tech anonymous ftp address (vtso.geol.vt.edu) or via the website http://www.geol.vt.edu/outreach/vtso/.

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